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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the woven knitted goods using the functional fiber which can change appearance, such as a color and a pattern, at any time, and a functional fiber. They are the woven knitted goods using the functional fiber which can change the color in an instant reversibly especially by voltage operation, and a functional fiber. The woven knitted goods of this invention are not only widely [as a garments raw material, a wallpaper raw material, etc.] available but impressing voltage locally, and are highly efficient woven knitted goods usable also as a display which can display a desired pattern, a character, etc.

[0002]

[Description of the Prior Art]Although advanced features of available woven knitted goods large as a garments raw material, a wallpaper raw material, etc. were progressing, it was difficult to change the pattern and color.

[0003]In the publication of registered utility model applications No. 3020011, it can wear ordinarily at a bright place, Signs that it did not see in a bright place in response to the light from a black light at a dark place, a sign, a character, etc. can be made to come up by a skillful luminescent state, the necessity for spare clothing is abolished, and clothes with the variability which heightens the stage effects in a dark place are indicated.

[0004]The electron-donative near-infrared absorptivity organic compound of (b) specification [JP,11-43864,A], (**) The compound, (**) aforementioned (b) which are electronic receptiveness to said organic compound, (**) the reversible heat fading layer which distributed and formed in the synthetic resin the minute capsule which made the compound which is a reaction medium which makes the electron transfer reaction by an ingredient occur reversibly in a specified temperature range include was provided -- the reversible thermochromism

endothermic fabric indication is carried out.

[0005]On the other hand, to JP,2551783,B, as shown in drawing 7, The electrophoretic display of the structure of having the microcapsule 37 in which the dispersing solvent 35 which consists of organic solvents, and the electrophoresis particles 36 were enclosed between the electrodes 33 and 34 formed in each surface of the substrates 31 and 32 which counter is indicated. In this electrophoretic display, at least one side encloses the dispersing solvent 35 containing the electrophoresis particles 36 between the counterelectrodes 33 and 34 of a transparent lot, It is an electrophoretic display which gives change to an optical reflection property and to which a necessary display action is made to perform by changing the distribution state of the electrophoresis particles 36 within a dispersed system under an operation of the voltage for display control impressed between these electrodes 33 and 34, The microcapsule 37 of a large number which enclosed the dispersed system which distributed at least one kind of electrophoresis particle 36 from which the dispersing solvent 35 and the optical characteristic differ is formed into the colored dispersing solvent 35, and it constitutes so that these microcapsules 37 may be ****(ed) between the above-mentioned electrodes 33 and 34.

[0006]

[Problem(s) to be Solved by the Invention]However, the woven knitted goods from which the conventional color and pattern like a statement change, for example to the publication of registered utility model applications No. 3020011 and JP,11-43864,A change with optical exposures, temperature, etc. from the outside, and a user is not changed arbitrarily.

[0007]On the other hand, as it is indicated to JP,2551783,B and shown in drawing 7, it is possible to change a display into the microcapsule 37 arbitrarily natural [the electrophoretic display which enclosed the dispersed system], but. In order to put the microcapsule 37 between the two substrates 31 and 32, thickness becomes thick, difficult, it is expensive to maintain pliability and it cannot use it widely as a garments raw material, a wallpaper raw material, etc.

[0008]The purpose of this invention is to provide a functional fiber with a user able to change the appearance of a color and a pattern at any time according to hope, and the woven knitted goods using this functional fiber.

[0009]The purpose of this invention is not only widely [as a garments raw material, a wallpaper raw material, etc.] available but impressing voltage etc. locally, and is providing highly efficient woven knitted goods with pliability usable also as a display which can display a desired pattern, a character, a picture, an animation, etc.

[0010]

[Means for Solving the Problem]A functional fiber of this invention is characterized by it being possible to make a necessary appearance change perform by being filled up with a dispersed

system which distributed migration particles, and changing a distribution state of said migration particles into a dispersing solvent, inside a transparent hollow filament.

[0011]In a functional fiber of this invention, said distribution state change is generated with voltage.

[0012]Woven knitted goods using a functional fiber of this invention, It has the structure which knit up a functional fiber with possible making a necessary display action perform by filling up a dispersing solvent with a dispersed system which distributed migration particles, and changing a distribution state of said migration particles into an inside of a hollow filament which has a transparent outer wall.

[0013]Woven knitted goods using a functional fiber of this invention, It has the structure which knit up into an inside of a transparent hollow filament a functional fiber with possible making a necessary display action perform by filling up a dispersing solvent with a dispersed system which distributed migration particles, and changing a distribution state of said migration particles as the weft and/or warp.

[0014]Woven knitted goods using a functional fiber of this invention generate said distribution state change with voltage (an electric field, an electric field).

[0015]Woven knitted goods using a functional fiber of this invention provided an electrode for voltage impressing at least in one side of structure which knit up said functional fiber.

[0016]Woven knitted goods using a functional fiber of this invention smoothed both sides of woven knitted goods which filled up with a filler a crevice between woven knitted goods which knit up said functional fiber, and were filled up with this filler, and provided an electrode in a this smoothed field.

[0017]

[Embodiment of the Invention]Hereafter, this invention is explained still in detail. Drawing 1 is an outline perspective view of the functional fiber 1 of this invention. This functional fiber 1 is a long fiber in which the dispersing solvent 3 and the migration particles 4 are included inside the hollow filament 2 which consists of transparent materials. Although a fiber means a single fiber and what bundled textiles may be defined as woven knitted goods in what is thread and finished weaving thread, let the thread of the state of a preceding paragraph story knit up in this invention be a fiber.

[0018]**** can make the section of said hollow filament 2 other shape as thread not only a circle but for an ellipse, a quadrangle, or textiles. It is also possible to transform an existing flexible material after creation by using as a hollow filament material.

[0019]A diameter is [the thickness of 1-1000 micrometers and a fiber outer wall] 0.01-300 micrometers, and, as for the fiber used for this invention, it is preferred that the ratios of a fiber diameter to outer wall thickness are 100:1-3:1. it is -- also rubbing -- in said less than range, fiber intensity runs short, and if said range is exceeded, display properties will deteriorate.

[0020]It is also possible to color the material of the hollow filament 2 beforehand or to form a colored transparent material layer in the surface of the hollow filament 2 further, and to color it it.

[0021]In order to obtain this functional fiber 1, the hollow filament use which fills up a fiber centrum with the dispersed system which created the hollow filament 2 first and included the migration particles 4 in the dispersing solvent 3 after that may be sufficient, but the wall thickness of a fiber becomes thick, and a process increases, and it has a fault of a high cost. For this reason, especially the functional fiber of the functional fiber of this invention really forms resin in that peripheral part created by extrusion formation (coextrusion process) is preferred, extruding a dispersed system from fine pores. It is possible to make wall thickness thin more by being filled up with a dispersed system using the charge of a wallplate reversible furthermore, impressing a pressure. If the fiber immediately after creating on that occasion itself impresses tension to a longitudinal direction and it performs it with enlargement, it is more effective for making wall thickness thin in a top. With the reversible charge of a wallplate, the thermoplastics which comes to have plasticity with moderate heating in the case not only of the plasticity in ordinary temperature but restoration can be used preferably.

[0022]When using a hollow filament, a hollow filament can be created by various kinds of publicly known methods. A typical method is the co-extruding method. or [this being the polymer and inertness which were dissolved in a suitable solvent or solvent system and obtaining it] -- or the fluid which is a solidified solution object or a precipitate fluid, and is obtained -- it co-extrudes. That is, a polymer solution is extruded through a circular orifice. Inactive fluid, a coagulation fluid, or a precipitate fluid is extruded from the hole of the center of a circular slit. This fluid is called a central fluid or a central medium. The character of the hollow fiber membranes which it is an ordinary custom making it run the inside of the short-time atmosphere of the range for 1/several seconds - several seconds, and were moreover obtained in the co-extrusion thing is influenced with the length of this air spacing. Continuously, usually a co-extrusion thing is extended through some fluid same as or different from a central fluid. As a central fluid, water and nitrogen gas are generally used widely. Creation by injection molding process etc. is also possible.

[0023]What is necessary is just to really use the below-mentioned dispersed system as a central fluid in the above-mentioned co-extruding method in extrusion formation. And the functional fiber which restoration of the dispersed system completed simultaneously with completion of a hollow filament, of course is obtained.

[0024]It is also possible to form a surface coating layer in the wall of the hollow filament 2 further. By using fluororesin etc. for this coating layer, adhesion in the wall of the migration particles 4 can be prevented effectively.

[0025]The dispersing solvent 3 used for "solvent" this invention Aromatic hydrocarbon and

aliphatic hydrocarbon. Publicly known solution compounds, such as what mixed independently or suitably halogenated hydrocarbon, oil and fat, such as a silicone oil, etc., compounds, such as a synthetic resin and a synthetic wax, natural wax, silicone oil, fluorine oil, etc. can be used. Fluorine oil, such as the fluid dispersing solvent which has linear-alkyl-benzene structure preferably while describing above, for example, n-amyl benzene, n-hexylbenzene, n-heptylbenzene, and n-octylbenzene, can be used.

[0026]A dispersing solvent is possible also for adding a color and coloring, and colors, such as oil colors, such as anthraquinone and azo compounds, etc. can be used for it as a color.

[0027]The "migration-particles" migration particles 4 can use impalpable powder, such as an inorganic pigment, a color, various organicity and a metal powder besides titanium oxide, carbon black, Prussian blue or Phthalocyanine Green, or a well-known colloidal particle, glass, or resin, etc. It is also possible to use only one only of kinds of these, and it is also possible to use two or more kinds of to use white particles and black particles especially, red, and three blue and green colors and to use the particles of white, black, red, and five blue and green colors further. For example, when monochrome 2 particles are used, white particles are drawn by foreign voltage by setting the electrification as positive/negative and reverse, black particles are repelled, it keeps away or a monochrome color change becomes possible because it will be in the reverse state. Drawing 4 shows the case where the black particles 4a and the white particles 4b which made electrification positive/negative are used.

[0028]As for the particle diameter of the electrophoresis particles 4, 0.01-10 micrometers is preferred. It can be made to be able to distribute suitably by making particle diameter into such a range, and movement speed can also be made into the speed which is satisfactory practically.

[0029]In order to improve control and dispersibility of the amount of surface charge of the migration particles 4 Stearic acid, Oleic acid, linolic acid, sodium dioctyl sulfosuccinate, polyethylene oxide, polymethylmethacrylate, a silane coupling agent, a titanium coupling agent, a silane coupling agent, etc. may be added.

[0030]In the ability to mass-produce economically with the reliability in a mass production as a synthetic resin which constitutes the "hollow filament" hollow filament 2, thermoplastic synthetic resin is preferred, For example, polyamide system synthetic resins, such as nylon besides the polyolefin system synthetic resin which consists of the homopolymer of alpha olefins, such as ethylene, propylene, 1-butene, and 4-methyl-pentene, a mutual copolymer, or such alpha olefins and the copolymer of other monomers, Polyester system synthetic resins, such as polyethylene terephthalate, a polyvinyl chloride system synthetic resin, a polyvinylidene chloride vinyl copolymer system synthetic resin, etc. are mentioned, and these two or more kinds may be blended. The ultraviolet curing resin etc. which can polymerize on-line can be used preferably.

[0031]To a resin composition, it is arbitrary to carry out specified quantity addition combination of the additive agents, such as a plasticizer, lubricant, an ultraviolet ray absorbent, a spray for preventing static electricity, fire retardant, colorant, and a bulking agent.

[0032]Although it is also possible to arrange the functional fiber of "weave" this invention in a single tier densely on a flat surface on the base prepared separately, it is very difficult on industry to put a thin fiber in order regularly, and slimming down and flexibility are spoiled by existence of a base. For this reason, in this invention, especially the structure that knit up the fiber without using a base is preferred.

[0033]The woven knitted goods using the functional fiber of this invention say what knit up the above-mentioned functional fiber. What used the functional fiber for warp and the weft, and knit it up as weave is common.

[0034]here -- woven knitted goods -- textiles in a narrow sense -- it is not things and the planate structure with which thread (fiber) of the large meaning was combined is said. For example, warp and the weft are not necessarily limited as crossing right-angled, but when both incline and cross, they are contained. Although there is also a definition made into the concept which differs in "weaving" saying "It knits", it uses as the meaning same as a means to finish setting up a fiber in this invention and to create the planar structure.

[0035]Therefore, the planar structure which limitation in particular does not have in weave and is done with various kinds of change and application, and combination as well as three typical weave, a plain weave, twill, and satin, can be used. Drawing 2 (A) shows an example of the woven knitted goods which pumped up said functional fiber 1 with warp and from which it pumped up the weft with the plain weave.

[0036]Of course, finishing weaving the woven knitted goods using the functional fiber of this invention only with the fiber of this invention can also be constituted combining the functional fiber of this invention, and fibers (a nonfunctioning fiber is called below) other than the functional fiber of this invention. Drawing 2 (B) shows the example which used the functional fiber 1 for warp (or weft), and used fibers other than a functional fiber for the weft (or warp).

[0037]Drawing 3 shows various examples of the weave which looked at weave to the axial center direction of the functional fiber, and the example of drawing 3 (A) is an example which used the functional fiber 1 for warp and the weft, or one side used the functional fiber, and another side used the nonfunctioning fiber 5, and carried out the plain weave like drawing 2 (A). The example of drawing 3 (B) uses the functional fiber 1 for warp (or weft), and uses the nonfunctioning fiber 5 for the weft (or warp), and weaves it into cross form. The example of drawing 3 (C) uses the functional fiber 1 for warp (or weft), the nonfunctioning fiber 5 is used for the weft (or warp), and to each functional fiber 1, the nonfunctioning fiber 5 is turned 1 round and woven in. The example of drawing 3 (D) uses the functional fiber 1 for warp (or weft), and uses the functional fiber 1 or the nonfunctioning fiber 5 for the weft (or warp), and

weaves in the nonfunctioning fiber 5 further to the weft (or warp).

[0038]Although the above shows the basic example which knits up the one weft and one warp by turns, the three weft can be summarized, for example and how depending on which finishing weaving with one warp etc. knits can also be applied. For example, it is also preferred to bend and use it as the weft in the right and left ends of textiles using one functional fiber long for whether your being Haruka as compared with the width of the textiles to finish weaving. After turning up one functional fiber and creating warp structure, it is also possible to finish weaving by using as the weft by return further one. Of course, it is also possible to knit up out of one functional fiber as what is called knitting.

[0039]Although it is usable in the cotton yarn which is not limited to the above-mentioned synthetic resin, but consists of natural fibers as a nonfunctioning fiber used for this invention, for example, wool cotton yarn, cotton-spinning thread, hemp cotton yarn, rayon cotton yarn, etc., it is a transparent material substantially preferably. By using a transparent material substantially, change of the color of a functional fiber and a pattern is observed clearly.

[0040]By impression of voltage, the woven knitted goods using the functional fiber and the functional fiber of "electrode" this invention can change reversibly the color which appears in the surface. The voltage impressing to the woven knitted goods using a functional fiber and a functional fiber can use publicly known various methods. It is preferred to provide an electrode on the woven knitted goods using a functional fiber or a functional fiber in it.

[0041]Drawing 4 (A) is filled up with the filler 8 which becomes a crevice between the woven knitted goods setting up was finished with the functional fiber 1 and the nonfunctioning fiber 5 using woven knitted goods with transparent resin etc., The electrodes 6 and 7 are formed in both sides of the woven knitted goods filled up with this filler 8, and the outside surface of the electrodes 6 and 7 is covered with the protective layers 9 and 10 which become with an insulation material, and is constituted in a sheet shaped. Drawing 4 (B) is the drawing of longitudinal section. When using such a filler 8, the nonfunctioning fiber 5 for banding the functional fiber 1 together is not necessarily required.

[0042]As the electrodes 6 and 7, various publicly known conductive materials, such as metal, carbon black, an oxide, can be used. The electrode formed in the transparent substrate used as a display surface should just use transparent electric conductors, such as ITO and ZnO. Or even if it is a non-transparent electric conductor, satisfactory transmissivity may be able to be obtained on use by forming very thinly. The electrodes 6 and 7 are formed in the shape of a film using such materials. What is necessary is just to form the electrodes 6 and 7 with the formation method by formation methods and the applying methods, such as wet process and vacuum deposition. And it is patterned if needed. The patterning can use a mask in the case of film formation, and can also carry out [the etching method using a publicly known photolithography, and] pattern spreading at it.

[0043]The woven knitted goods of this invention are in the state where the functional fiber was finished weaving, and itself is able to deal with it as a plane structure. That is, in the conventional electrophoretic display, since there was a base for maintaining structure, slimming down, pliability, etc. have restriction and the product price was high by the price of a base at least. On the other hand, it is not necessary to use the base only for only supporting structure in this invention. In this invention, the sum total of the thickness of stratum functionale, such as conductive layer thickness and protective layer thickness, is preferably thin to woven-knitted-goods thickness. That is, woven-knitted-goods itself is a main structure, and stratum functionale, such as conductive layer thickness and protective layer thickness, is auxiliary layers to the last. It becomes possible to suppose that it is thin and cheap with constituting in this way.

[0044]The woven knitted goods by this invention are in the knit state, and it is also possible to use it as it is. In this case, appearance change is made to cause using an external voltage applying device by impressing predetermined voltage to the functional fiber of this invention, and woven knitted goods. It is also effective in local voltage generating to provide an electrode (there is no transparent necessity) only in a rear face, and to impress voltage between external electrodes, and it is desirable.

[0045]As this invention was preferably shown in drawing 4 and drawing 5, the electrodes 6 and 7 for voltage impressing are formed on woven knitted goods. Coat the both sides with the filler 8 which becomes with insulating resin, such as urethane, about woven knitted goods, and with it For example, a breakthrough, That is, after closing the crevice between the functional fibers 1 and 1, or the crevice between the functional fiber 1 and the nonfunctioning fiber 5, the electrode 6 or 7 which becomes at least one side with a transparent conducting film, or an ultra-thin non-transparent conducting film is formed. They are conductive resin or a coating mold ITO (indium tin oxide) film especially preferably.

[0046]The display of this invention not only in the electrophoretic display which gives an electric field to migration particles by the electrode formed in the surface on which a substrate counters, An electric field and electrification can be given to particles with external devices (a voltage impressing pen, a voltage impressing head, an electrostatic ion flow device, etc.), and it can also be considered as the display which displays by controlling the distribution state of particles. The functional fiber of this invention can use not only the thing containing electrophoresis particles but magnetic migration, and can also use it as the appearance change type by the magnetic migration which displays by impressing a magnetic field from the exterior and controlling the distribution state of magnetic migration particles. Various kinds of control devices, such as a control circuit for controlling voltage and a memory circuit, may be combined.

[0047]The principle of operation of the woven knitted goods shown in drawing 4 using drawing

5 "of operation" is explained. If voltage is impressed between the electrodes 6 and 7 as shown in drawing 5 (A), the electrified migration particles 4 will move to the electrode side contrary to the electrification. As a result, the color of migration particles is observed in the surface. On the other hand, in a rear face, the color of the solvent 3 will be observed. If the voltage of drawing 5 (A) and an opposite direction is impressed as shown in drawing 5 (B), in order that the migration particles 4 may move to the rear-face side shortly, from the surface, as for a rear face, the color of the migration particles 4 will be observed for the color of the solvent 3. The migration particles which once moved are crossed to a long time, and in order to stop at a place as it is, even if it stops voltage impressing, the once displayed color does not change. If the migration particles 4 are uniformly distributed in a dispersed system like drawing 5 (C), it will become a solvent and a mixed color of the color of migration particles. What is necessary is just to impress a high-speed (10-100 Hz) volts alternating current to inter-electrode comparatively, for considering it as such a distribution state.

[0048]As for "smoothing of electrode formation face" electrodes 6 and 7, forming in the smooth surface is preferred. Since deviation arises in distribution of voltage when the electrodes 6 and 7 are formed on the field of the irregular woven knitted goods which gave the filler 8, as shown in drawing 6 (A), desired voltage cannot be impressed. For this reason, as shown the surface of insulating resin coating used as the filler 8 in drawing 6 (B), in order to make it smoother, It is also a desirable method that the surface prepared separately sticks an insulating resin coating surface with a smooth substrate etc. positively the filler 8 not only utilizes the leveling operation by non-dryness, but, and the surface transfers smooth substrate face shape. The surface is not monotonously restricted as a smooth substrate etc., but it can also use smoothing both sides simultaneously preferably by passing between a cylindrical shape (rolled form) board, especially two heated cylindrical substrates. When smooth nature can be evaluated using a surface roughness meter, it is 1/10 or less that the wave (Wca) searched for from the curve which removed the ingredient of short surface roughness is 1/5 or less [of the distance between the surfaces of insulating resin coating] desirable especially preferably. A minimum does not have restriction in particular. When exceeding said range, deviation arises in distribution of voltage.

[0049]They are reacting to heat, reacting incombustibles and/or non-flammable gas to containing generating and/or the self-extinguishing substance which carries out an endothermic, and heat, and containing a foaming ingredient, and the woven knitted goods of this invention can acquire high fire retardancy, and are preferred. in evaluation based on the vertical flame test by UL-94 (under writer ZURABO -- rattly) standard of generally specifically being used, the display of this invention is having the fire retardancy more than "V-0" grade.

[0050]

[Example]Hereafter, an example is given and it explains concretely.

[0051][Example 1] White titanium oxide 12 weight section with a mean particle diameter [as the migration particles 4] of 0.8 micrometer, Beta perfluoro heptyl ethyltrimethoxysilane of the amount part of duplexes as a dispersing agent, What mixed blue dye of one weight section for dispersing solvent coloring and the fluorine oil (Sumitomo 3M FURORINATO) of 85 weight sections as a subject of the dispersing solvent 3 by ultrasonic dispersion was prepared, and it was considered as the dispersed system. Next, the functional fiber which created polyethylene by the co-extruding method as the wallplate 2, i.e., a hollow filament, is made into Example 1 by using a duty powder system as heartwood. About 60% of the diameters immediately after extrusion were used by extending applying tension to a fiber immediately after extrusion. Example 1 had the almost circular section, the average diameter was 50 micrometers and wall thickness (thickness of the hollow filament 2) was 2 micrometers.

[0052][Example 2] White titanium oxide 12 weight section with a mean particle diameter [as the migration particles 4] of 0.8 micrometer, What mixed the silane coupling agent of a dispersing agent, oleic acid of 1.5 copies for surface charge adjustment, and 0.5 weight sections, black dye of one weight section for dispersing solvent coloring, and the silicone oil of 85 weight sections as a subject of the dispersing solvent 3 by ultrasonic dispersion was prepared, and it was considered as the dispersed system.

[0053]And the functional fiber was obtained by irradiating with ultraviolet rays simultaneously, extruding ultraviolet curing nature resin by the co-extruding method as the wallplate 2, i.e., a hollow filament, by using the above-mentioned dispersed system as heartwood. Thereby, the section obtained an average of 30 micrometers of a square and a length of one side, and the functional fiber of 10 micrometers of wall thickness, and made this Example 2.

[0054][Examples 3, 4, and 5] In Example 2, the functional fiber 1 using what colored ultraviolet curing nature resin of the raw material red, green, and blue using the color as the hollow filament 2 is made into Examples 3, 4, and 5, respectively.

[0055][Example 6] after finishing weaving to a plain weave by using the functional fiber 1 of Example 1, and transparent polyethylene terephthalate thread 10 micrometers in diameter as said nonfunctioning fiber 5, After repeating dip coating and desiccation 3 times in the toluene content urethane resin solution as the filler 8, the surface made the surface smooth further using two smooth metallic rolls. Then, the conductive resin as the electrodes 6 and 7 and resin as the protective layers 9 and 10 were applied in order, and it was considered as the functional woven knitted goods of Example 6.

[0056]When the voltage of 30V was impressed to each inter-electrode one of the table of the woven knitted goods of Example 6, and the reverse side, the blue whose surface is a color of the dispersing solvent 3, and a rear face changed to the white which is a color of the migration particles 4. Next, when impressed electromotive force was made reverse, the surface changed to white and the rear face changed to blue. This change was reversible and variation speed

was 100 ms. Even if it stopped voltage impressing, the color in front of that was held.

[0057][Example 7] The 500 hollow filaments 2 of Example 3 continue a functional red fiber as warp, Consider it as the warp of the width and the 500 hollow filaments 2 of Example 4 continue a functional green fiber, The 500 hollow filaments 2 of Example 5 continue a functional blue fiber, The functional fiber of red [hollow filament / 2 / of Example 3] still more nearly similarly, a functional fiber with the green hollow filament 2 of Example 4, The hollow filament 2 of Example 5 to the warp which carried out multiple-times creation of the repetition of a functional blue fiber. After having used transparent polyethylene terephthalate thread as the nonfunctioning fiber 5 10 micrometers in diameter for the weft, carrying out a plain weave, dipping-applying to the toluene content urethane resin solution for filler 8 and drying in it, the surface made the surface smooth using two smooth metallic rolls. Then, the protective layer 9 and resin for ten were applied to the carbon content conductive paint for electrode 6, and both sides in order only at one side, and it was considered as the functional woven knitted goods of Example 7.

[0058]When the voltage of 30V was impressed between the copper plate and the woven-knitted-goods conductive layer, sticking the copper plate formed in the exterior of Example 7 on the woven-knitted-goods surface of Example 7, the whole surface became black and was initialized. And when the voltage impressing pen was contacted on the woven-knitted-goods surface and the line was drawn, impressing the voltage of 20V contrary to the time of initialization at the electrode 6 which consists of a conductive paint layer of woven knitted goods, and the tip of a voltage impressing pen provided outside, one line which changes to red, green, blue, and three colors was formed on woven knitted goods. That is, after the white migration particles 4 have moved to the display surface by contact of a voltage impressing pen, the red who is a color of the hollow filament 2, and a green or blue color appear, and when the migration particles 4 are in the rear-face side, the black of the dispersing solvent 3 appears.

[0059]When initializing voltage contrary to a voltage impressing pen was impressed between the copper plate and the conductive paint layer of woven knitted goods, sticking again the copper plate formed outside for elimination on the surface of the woven knitted goods of Example 7, it has been checked that the whole surface became black and had been initialized again.

[0060][Example 8] In addition, in Example 6, after dipping-applying to the toluene content urethane resin solution for filler 8 and drying in it, what did not perform smooth surface-ized processing using a metallic roll was made into Example 8. In this Example 8, about 17-micrometer wave had arisen in the direction right-angled on a fiber (Example 6 about 3 micrometers). Since the distance between the surfaces of insulating resin coating was 70 micrometers, the 1/5 is 14 micrometers, and 1/10 is 7 micrometers. The heights of a crevice of

this wave corresponded between fibers in accordance with the fiber part. And when the same evaluation as Example 1 was performed, change of contrast was an abbreviation half compared with Example 1.

[0061]

[Effect of the Invention]According to this invention, a functional fiber with a user able to change the appearance of a color and a pattern at any time according to hope and the woven knitted goods using this functional fiber can be provided. It can not only be widely [as a garments raw material, a wallpaper raw material, etc.] available, but according to this invention, it can provide the woven knitted goods usable also as a display which can display a desired pattern, a character, a picture, an animation, etc. which it is thinly cheap and are easy to bend by impressing voltage locally.

[Translation done.]